Assessing ATM impacts and interactions

An interactive introduction and workshop
for the SESAR ER project 'Domino'

04 June 2019

SESAR JU, Brussels

SESAR JOINT UNDERTAKING

Founding Members

EUROPEAN UNION EUROCONTROL

Introduction to the team

Agenda (1/3)

- **Session 1** (UoW)
  - High-level introduction to Domino and its objectives
  - Brief feedback from the AU's workshop
  - Quick *tour de table* – one sentence why you came

- **Session 2** (UoW)
  - More details on the model
    - events, mechanisms and scenarios
    - benefits to stakeholders

- **Session 3** (UoW)
  - Behaviour of agents in the model (examples)
  - Introduction to metrics capabilities

Agenda (2/3)

- **Session 4** (UniBo)
  - Design of metrics, adding value
    - ‘classical’ *versus* ‘non-classical’ metrics

- **Session 5** (UniBo, UoW)
  - First results and discussion
    - are these results as expected?

- **Session 6** (UNITS)
  - *“What would <u>you</u> like to get from a tool like Domino?”*
    - please suggest what <u>research questions</u> you would like answered

1

Agenda (3/3)

- **Session 7** (UNITS)
  - "***What metrics in Domino could you use to answer your research questions from previous session?"***
    - what new metrics might be needed?

- **Session 8** (UoW)
  - Next steps
    - further feedback: what should we prioritise as future scenarios?

- **Session 9** (UoW)
  - Taking stock
    - conclusions from the day
    - actions on the Domino team

    (close by 1700)

High-level introduction to Domino

Project goals and objectives

Develop a set of **tools**, a **methodology** and a **platform** to assess the coupling of ATM systems from a flight and passenger perspective

Project goals and objectives

A reminder of the scope

- Domino **not aiming at reproducing specific SESAR Solutions** in detail
- Focuses mainly on analysing **network impact** of changing elements in system
- Selected mechanisms **aligned with some SESAR concepts** of operations:
  - UDPP, E-AMAN, 4D trajectory management (e.g. dynamic cost indexing)
  - extending beyond current definition (with inclusion of '**Level 2**')

(Later)

Relationship with EATMA

Return to if helpful
(also slide on validation)

- Domino will provide a methodology, model and set of tools to analyse network impacts of changes in ATM system
  - methodology & tools **could be applied in future to outcomes from (e.g.) SESAR projects or Solutions,** or historical data (including instantiation of EATMA)
  - Domino thus useful regardless of similarities/differences re. EATMA
- EATMA provides disaggregated detail of description of activities, while **Domino focuses on more high-level functionality** descriptions
  - Domino models interactions at system level; EATMA describes subsystems, messages and protocols
  - Domino's ABM approach could be extended to incorporate EATMA elements*
- Domino will flag at a high level, elements of EATMA that are taken into consideration

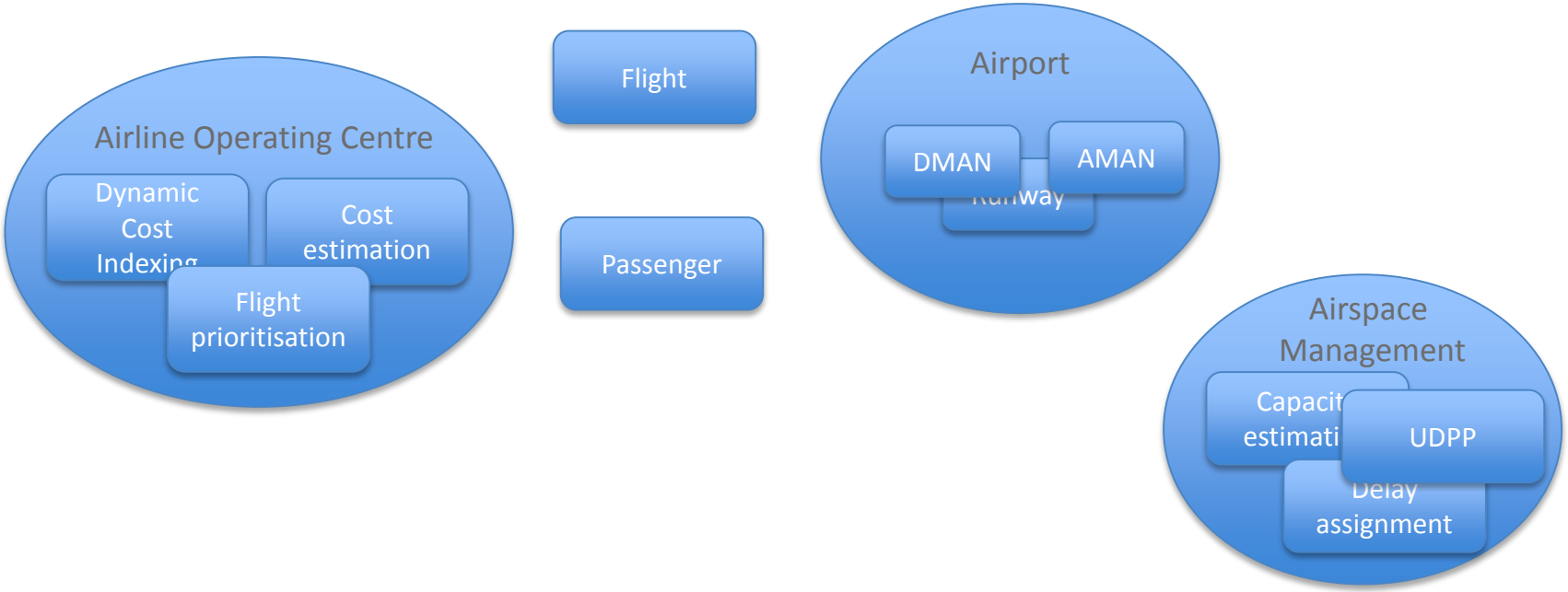
<u>One could agentify some parts of EATMA and incorporate these new agents in the Domino platform</u>

* This modularity and flexibility will be described in the project as part of the methodology and is taken into account while carrying out the design of the model platform in D4.1, for example by using a well-defined design methodology (Gaia) and ensuring the modules in the agents are decoupled and use standardised methods of communication.

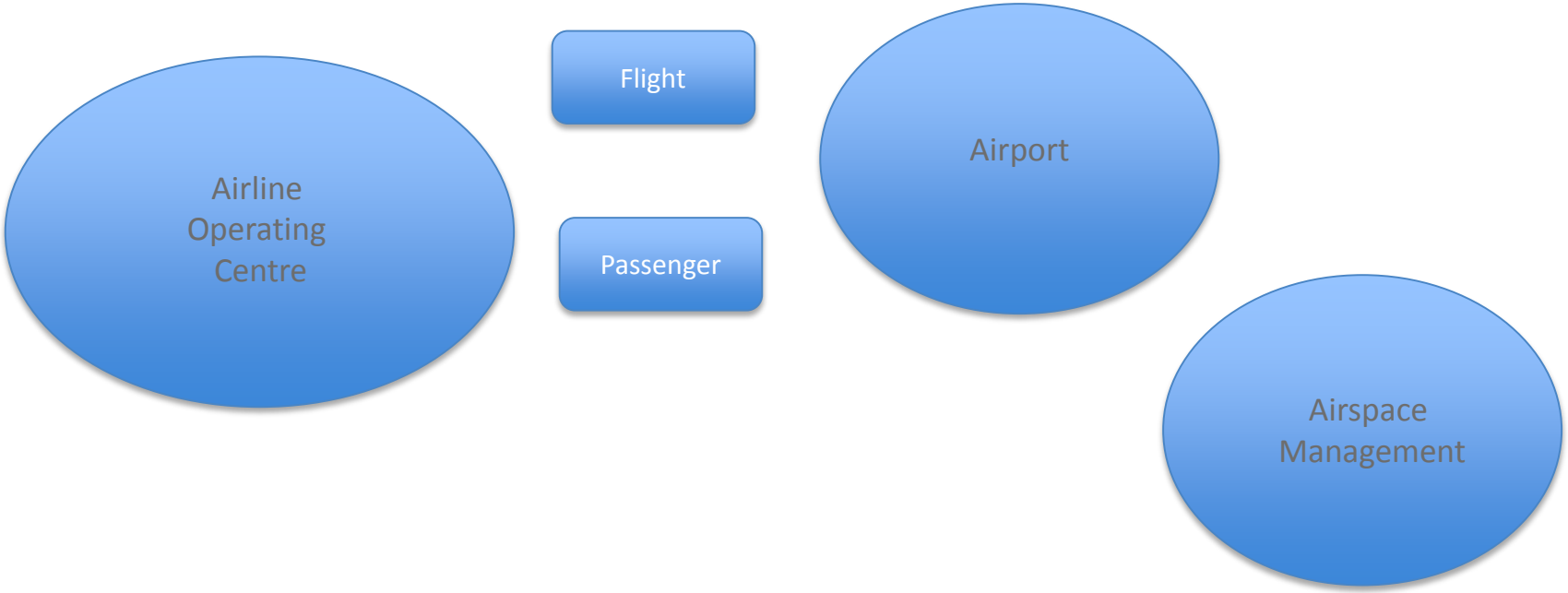
Project goals and objectives

Specific challenge

- Architecture of ATM system is complex



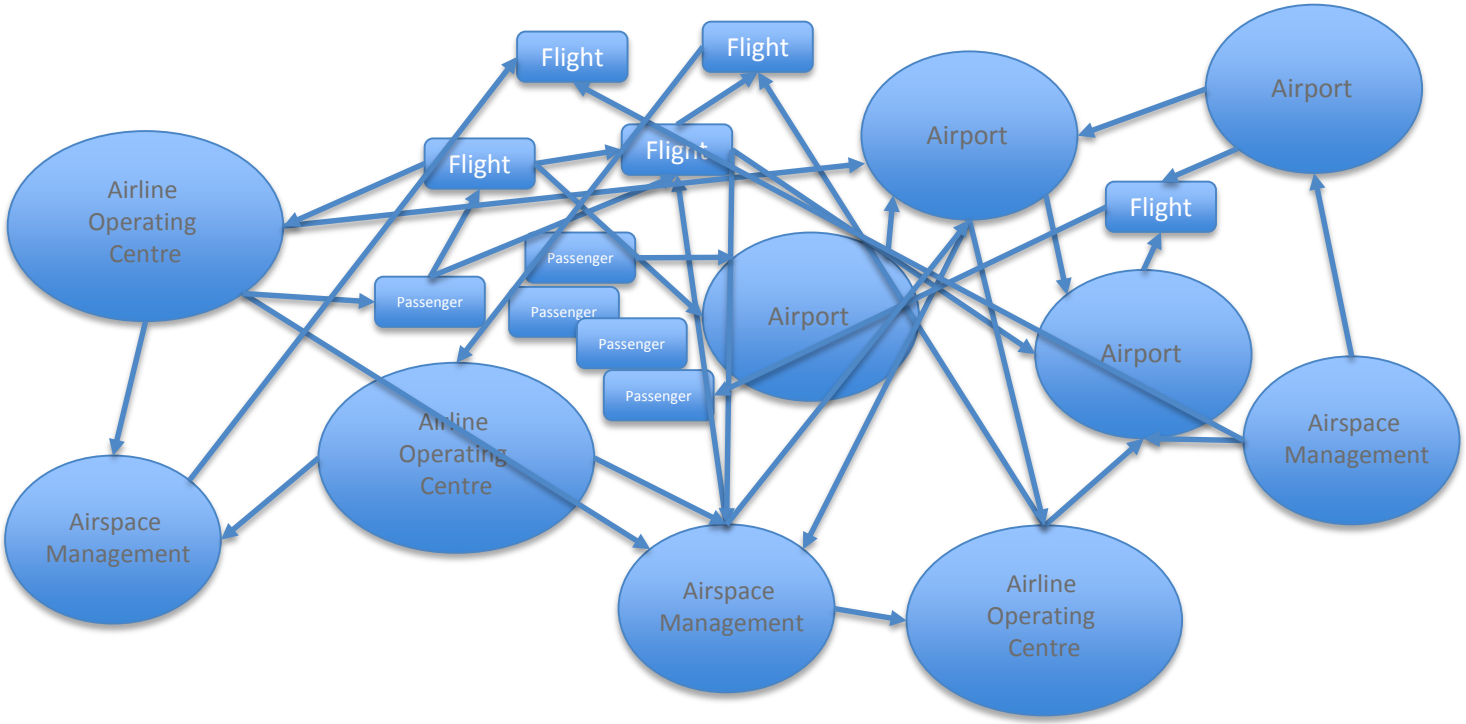
Project goals and objectives



Project goals and objectives

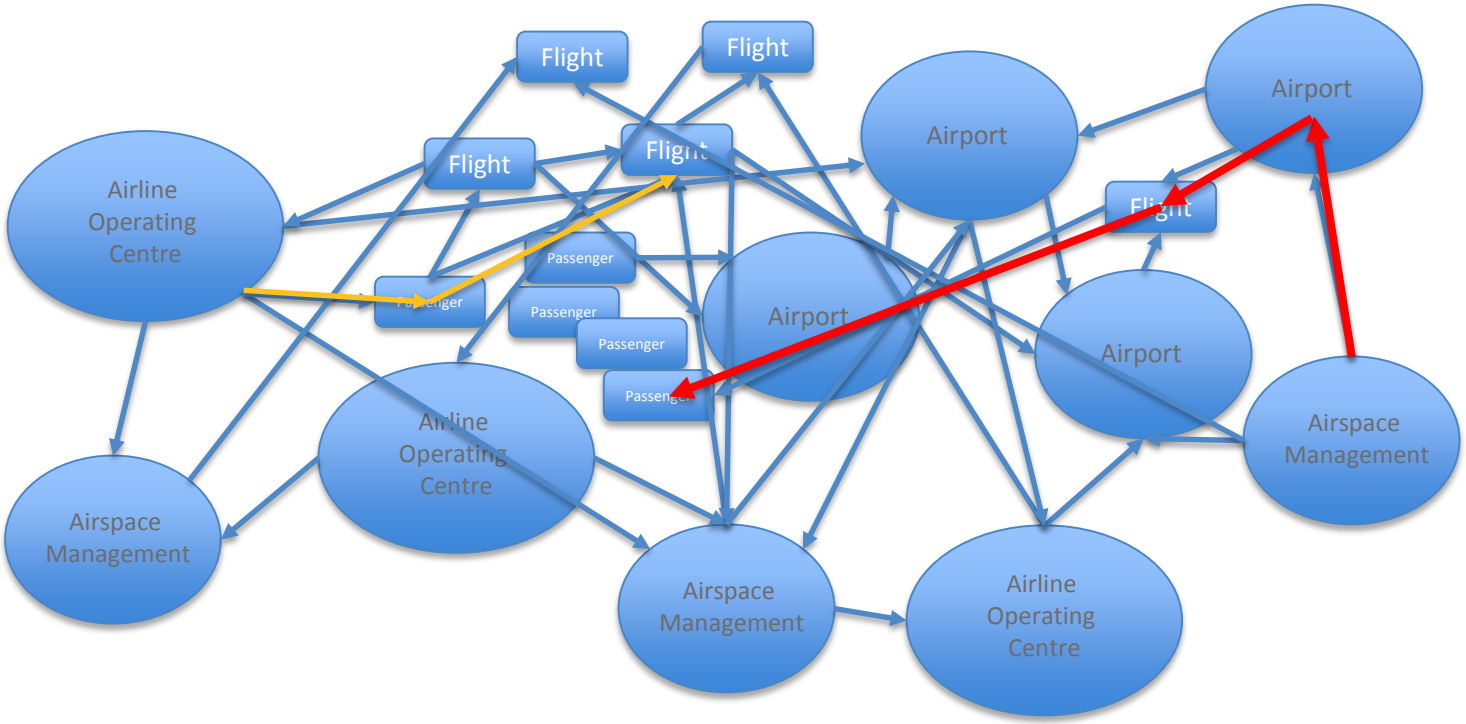
Specific challenge

- Introducing change into this system is often difficult due to tight interdependencies

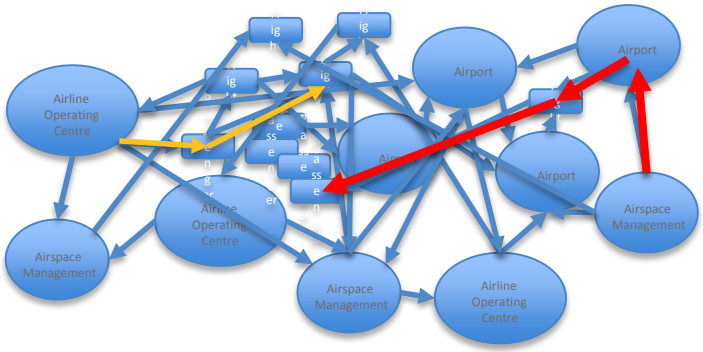


Project goals and objectives

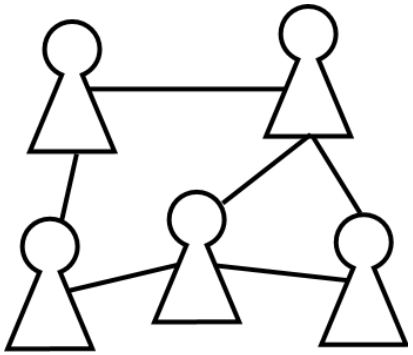
Propagation of delay/cost through the elements in the network



Project goals and objectives



Different actors
- Interacting (cooperation/competition)
- With rules defined by system
- Considering own utility functions (cost/delay)



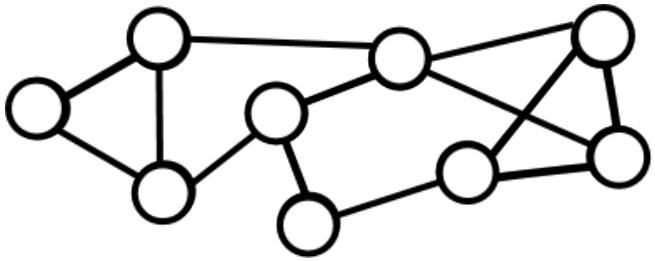
Changes in the system
- Modify the rules by which the actors operate
- Change the degree of uncertainty
- Modify the degree of competition/cooperation

Project goals and objectives

Contrasting stakeholder perspectives

Flight

Passenger



Project goals and objectives

- Create a **toolbox**
  - To analyse coupling of system
    - identify which elements would be *a priori* affected by changes in system
  - Identifying, testing, validating metrics (e.g. based on complexity science)

- Provide a **methodology**
  - Defining case studies based on selected mechanisms
  - Apply model, methodology & toolbox to investigative case studies
  - Modify investigative case studies to generate adaptive case studies
    - aiming at mitigating negative network effects
  - Describe how methodology & toolbox can be applied to historical data

- Create detailed **agent-based model**
  - Capturing interactions between stakeholders & ATM elements
    - working in close cooperation with stakeholders
    - generating realistic behavioural and cost functions

DCB and traffic data used

Capturing higher demand

- **Some infrastructure already struggling with capacity/demand issues,** therefore intro of mechanisms should represent improvements (e.g. LHR)
  - could partly focus results on metrics for such elements

- **Baseline day selected in 2014 is one of the busiest days**
  - with demand thus similar to an average day in 2023 (baseline forecast)

- Will **consider flight and passenger delay, and cost of delay**
  - thus higher sensitivity re. capturing changes due to intro of mechanisms

Airspace Users' Workshop

EUROCONTROL Experimental Centre (07MAY19; PJ.07-02, UDPP)

- follow-up meeting at UoW, 16MAY19

Six key points (full report in D6.3)

- most FPL & recovery assumptions in model reasonable (10 min threshold)
- wide range of awareness re. cost of delay / pax wait rules (lower for LCCs)
  - high awareness of 'priority' flights (low daily variation) & tactical outliers
- aircraft swaps (rotation lines) often first recovery option, *where possible*
  - future work (NB. often occur with a cancellation)
- crew dependencies & maintenance constraints often important
  - future work
- curfew constraints ('hard' & 'soft') often drive early rotation decisions
  - room for refinement
- pilot autonomy (officially) is usually very low

Tour de table ...

- **Domino team & SJU colleagues**
  - name and affiliation; we are here to improve the model and its alignment with stakeholder needs by listening to our invited guests

- **Invited guests**
  - name and affiliation; particular perspective and/or how you hope you may benefit by investing your time today

Session 2...